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REPORT ON BIGHORN SHEEP HABITAT STUDY IN THE AREA FOR WHICH AN APPLICATION WAS MADE TO EXPAND THE MT. BALDY WINTER SPORTS FACILITY

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REPORT ON

BIGHORN SHEEP HABITAT STUDY

IN THE AREA FOR WHICH AN APPLICATION

WAS MADE TO EXPAND THE

MT. BALDY WINTER SPORTS FACILITY

By

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Requested By

District Ranger Edmond Richardson
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San Bernardino National Forest

INTRODUCTION

The rapid human population growth and the greatly accelerated use of land occurring in the southern California National Forests have and will cause drastic changes in wildlife habitat. New roads, mining, real estate development, recreation area development and increased visitor-day use are shrinking the natural and undisturbed public land base. If wildlife, and its habitat are to continue to exist on public lands a much better understanding of wildlife habitat elements is essential. A quantitative and qualitative analysis of existing plant communities and the extent to which wildlife depends on these plant communities must be determined.

The San Bernardino National Forest began in 1964 to inventory and analyze the Forest's wildlife habitat. In 1965, the habitat of the bighorn sheep (Ovis canadensis), was first inventoried on the Forest. The San Gabriel Bighorn Habitat Management Plan (Light, 1967) provided detailed management direction for the maintenance and protection of this species in the San Bernardino and Angeles National Forest.

On July 7, 1969, Mt. Baldy Lifts, Inc. made application to extend the existing Mt. Baldy ski development deep into bighorn summer range in the San Bernardino National Forest. Mount San Antonio (Mt. Baldy) rises above 9 million people in the Los Angeles - San Bernardino Basin approximately 150,000 - 200,000 of whom are skiers. At least as many have other recreational aspirations. Many expressions of concern for the bighorn sheep, which are native inhabitants of this rugged landscape have been received.

The "Baldy Public Meeting" (June 17, 1970) expressed, by concensus of the public, that more information on bighorn and the area was needed before the area be dedicated to intensive recreation area expansion. With this public expression and through the Cajon Ranger District Multiple Use Management Plan and the National Environmental Policy Act, the San Bernardino National Forest initiated an environmental analysis of the Mt. Baldy area within the San Gabriel Mountains. Geologic, hydrologic, soils, wildlife and vegetation information were obtained by specialists in each field. This analysis of bighorn sheep habitat is only a part of the Environmental analysis. Objectives for the bighorn habitat analysis were:

1. Determine bighorn range by observing the species yearlong movements.

2. Determine the quantitative and qualitative aspects of the bighorn habitat.

3. Determine the extent of current public use and where to expect human travel and concentration areas in bighorn range in the event of development.

4. Determine bighorn behavior responses to man in as many environmental situations as possible.

5. Analyze the effect of habitat alternations or disturbance through ski area development and use, summer recreational use and logging of timber.

6. Make recommendations pertaining to the proposed development based on the results of this analysis.

The bighorn analysis began in the Fall of 1969 and was continued through the Spring of 1971. The analysis was performed by wildlife biologists of the Forest Service and California Department of Fish and Game.

ACKNOWLEDGEMENTS

The coordinator of the environmental analysis, Edmond Richardson, Cajon District Forest Ranger appreciates the active participation of Richard Weaver, Jerry Mench, Jack Spruill and Wes Timmerman of the California Department of Fish and Game and the assistance of Forest Service personnel, including the Angeles National Forest Wildlife Biologist and summer forestry technician biologist, Edwin Wessman. Special thanks is offered Philip Riggan and Jan Larson of the Systems Ecology group at California State University, San Diego for their relentless efforts in the statistical analysis of the gathered data. Approximately 3-man years of field work were involved in an 18 month period.

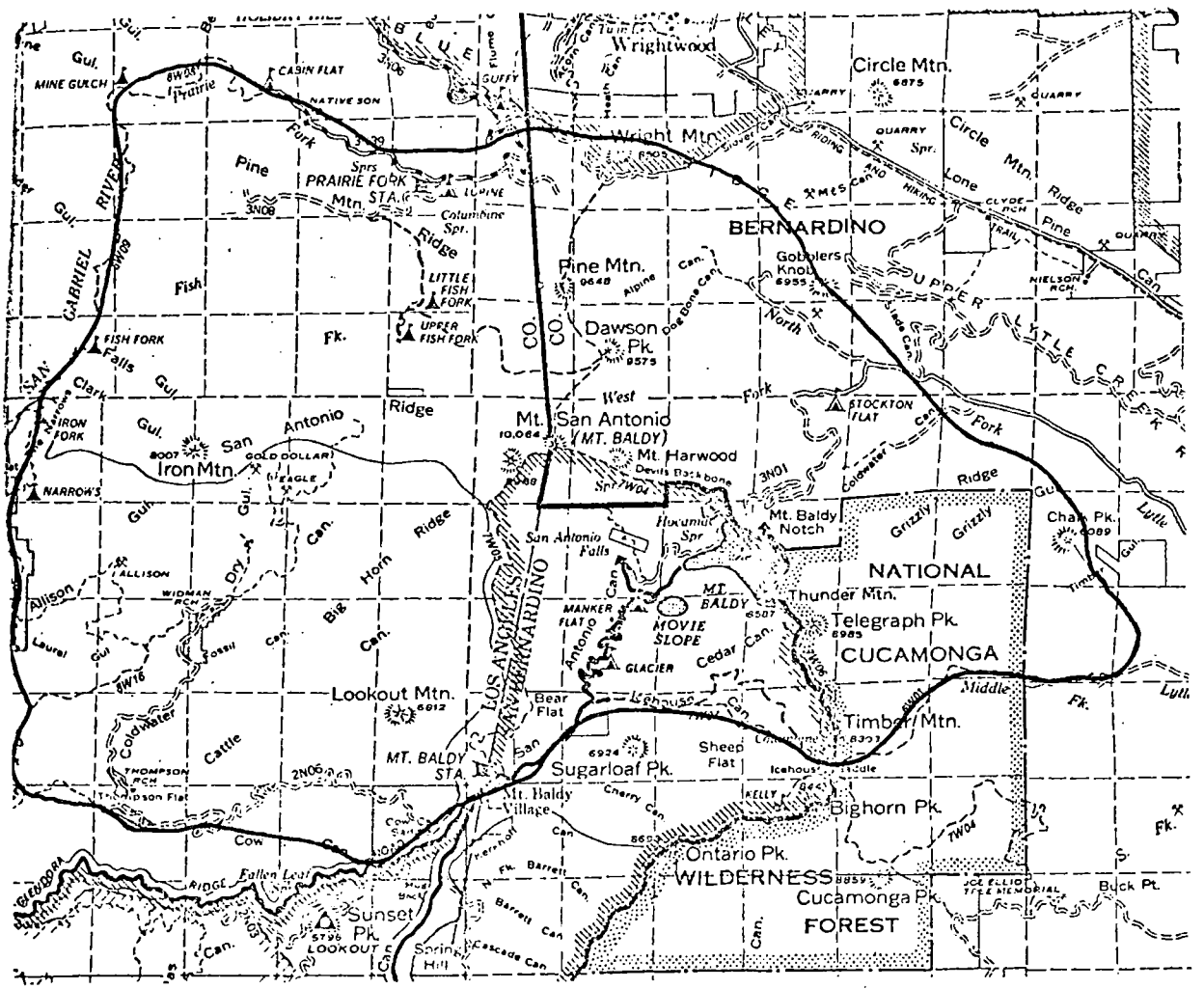
Additional bighorn observations were provided regularly by Bill MacIntire of Lancaster, California and Dr. Loren Lutz, of the Society for the Conservation of Bighorn and members of local Chapters of the Sierra Club. Consultation offered by members of the Desert Bighorn Council is also appreciated.

STUDY AREA

DESCRIPTION

The sixty square mile survey area within both the Angeles and San Bernardino National Forests includes Pine Mountain, Dawson Peak, Mt. Baldy, Mt. Harwood, Iron Mountain, Telegraph Peak and Blue Ridge of the San Gabriel Mountains. Principal watersheds in the survey area are Cattle, Coldwater and Fish Fork canyons of the East Fork of the San Gabriel River, San Antonio Canyon and the North and Middle Forks of Lytle Creek.

The bighorn sheep range varies in elevation from the top of Mt. Baldy at 10,064 feet to approximately 3,500 feet in the East Fork of San Gabriel River and Middle Fork of the Lytle Creek canyons.



Geology of the survey area is typical of the Transverse Mountain Range, of which the San Gabriel Mountains are a part, and consists of upward thrusted fault blocks which formed this mountain range. The major geologic formation

is the Pelona schist, impregnated with granitic intrusions. Of special interest to bighorn distribution patterns are the narrow ridges and deep canyons which provide escape terrain in close proximity to water and forage. Aqeous springs arising through a "gouge" geologic material, bear inorganic nutrients in the water and mud which are regularly consumed by local bighorn. Gouge, a finely abraded material, occurring between the walls of the fault, is the residue from the grinding movement (Morgan, personnal communication).

Climatological information was recorded at Baldy Notch within the study area at an elevation of 7,735 feet. Generally, precipitation in the study area is quite static. Annual average precipitation is approximately 40 inches (1962-1969). Minimum and maximum departures from this average annual precipitation are 17.17 to 98.47 inches, respectively. Precipitation in the form of snow usually occurs from November through March and occasionally into April. Except for infrequent warm winter storms, rain usually occurs during the spring and summer months from thunder showers. Temperature recorded at Baldy Notch indicates the following seasonal range.

Winter	0	to	35 degree F.
Spring	27	to	51 degree F.
Summer	51	to	67 degree F.
Fall	36	to	54 degree F.

Temperatures at the lower 3,500 foot elevations vary from winter lows of less than 30 degree F. to summer highs of 100 plus degrees F.

Bighorn movements correlate with local climatic conditions by avoiding exposed ridges during cold and windy periods and by utilizing these areas during warm periods. Inversion layers create favorable conditions or thermal comfort zones at higher elevations favoring lambing and elevational drift of bighorn.

Plant communities which influence bighorn movement in the study area are, from lower to higher elevations:

Chaparral
Pine Forest
Alpine Forest
Alpine barren

Within these basic plant communities lie the escarpment or cliff and riparian vegetation associations. All the plant communities are used by bighorn to obtain food. Of importance is the interrelationship of plant communities with bighorn movement habits. Plant development and abundance being dependent upon season, climate, topography and relief appears to have an influence on bighorn movement. Bighorn movement resulting from this interrelationship can be predictable (Geist, 1971).

The more common vertebrate organisms observed in the survey area include Mt. bluebird, violet-green swallow, Clark's nutcracker, mountain quail, rufous-sided towhee, California thrasher, golden eagle, lodgepole chipmunk, coyote and a few southern mule deer. Aquatic vertebrates include the rainbow trout in the Fish Fork tributary of the East Fork of the San Gabriel River. The area includes 10 species of snakes, 7 species of lizards, 2 species of skinks,

2 species of frogs and 2 species of salamanders. The analysis did not seek out habitat competition relationships between bighorn and these other vertebrate species. No obvious competition indicators appeared to be present. It would seem that deer would be their greatest competitor for forage. This however, was found not to be the case since deer appeared to be transitory visitors and did not concentrate in the study area. Predators such as coyotes, bobcats, mountain lion and golden eagle were noted in the area. On occasion the golden eagle was observed harassing the bighorn. Vertebrates in the survey area classified as threatened by the State include the Gilbert's skink and southern rubber boa.

Bighorn poaching removes from 1 to 3 bighorn annually in this area. Man's influence through this activity and his influence through shear numbers are of particular importance to bighorn occupying key habitat areas.

CURRENT LAND USE

Land Use in the study area during the time of the analysis was as follows:

Recreation - Hiking and backpacking, fishing or bighorn viewing are the major uses in the study area and normally occur during the spring, summer and fall months of the year with the greatest use occurring from Baldy Notch and Baldy village to the top of Mt. San Antonio. Motor vehicle use occurred from Stockton Flats and Baldy Notch to Devil's Backbone and from Prairie Fork campgrounds into the upper Fish Fork drainage via old logging roads. Evidence of shooting or target practice has been observed on all trails and at Bighorn and Stockton Flats campgrounds. Horseback riding was not observed in the study area. Summer recreation use of the Mt. Baldy area has adversely influenced bighorn use of the area. Since 1952, when the Forest Service issued a special use permit for skiing in the Baldy Notch area, bighorn have circumvented this area by trailing around the east side of the Notch just out of view of the center of the resort where human activity is concentrated.

Mining - Mineral exploration is still active in the study area in Cattle Canyon and Coldwater Canyon (Lytle Creek). Efforts are being made to withdraw these areas from mineral exploration.

Private Land Use - Approximately 260 acres of private land, including the Widman Ranch, Airplane Flat and Bighorn Mine are within bighorn habitat. Bighorn are absent in suitable habitat surrounding these lands. Much of the land use is summer home sites for recreational use.

Timber - Approximately 2 million board feet of timber was harvested out of the Stockton Flat area in 1970. The timber was removed during the winter to lessen the impact on bighorn that occupy the area during the spring and summer months.

Grazing - Grazing of livestock does not occur in bighorn range in the San Gabriel Mountains primarily to prevent disease outbreak (lung worm-pneumonia complex) in bighorn and reduce competition for forage.

METHODS AND PROCEDURES

BIGHORN OBSERVATIONS

The study area was delineated using past bighorn sightings. The bighorn observations were thereafter recorded on a data sheet, including time, weather, topography, relief, vegetative type, classification and age of animals observed, time, behavioral activity of animal, relate position and reaction to observer (1-Unconcerned, 2-Curious, 3-Concerned, 4-Slow retreat, 5-Fast retreat and 6-Startled), and time length of feeding by plant species. Observation records were then given a chronological number and keyed to a 4" to the mile scale topographic map. Each single animal or single group of animals observed were recorded on one observation form. Observation records were grouped by method of observation: helicopter or by foot travel.

Helicopter - Method of travel was to contour at 500 foot intervals the entire study area below the snowline. Once all bighorn areas in the winter and summer range were determined, a flight plan was determined to link concentration areas together in a manner that would be most economical and time-saving.

Foot Travel - Observations were made from wherever the hiking field observers could view the animals. Optical equipment used included 20 to 40x spotting scope and binoculars (7x40). Behavior reactions were generally recorded from accidental confrontations with the bighorn. On occasion confrontations with bighorn were staged where observers were posted to watch reactions of the animals to an approaching group of men.

HABITAT ANALYSIS

During the observation phase the bighorn habitat types, stratified by degree of bighorn use, were formally surveyed with the analysis data recorded on the Habitat Analysis form. Each habitat type description was delineated and legend to the map. Data recorded on this form included:

Vegetation and Ground Cover - Percent ground cover, plant composition and density was determined by the standard Forest Service "Toe-point Analysis" method.

Evidence of Bighorn - The minimum and maximum number of beds per bedground were enumerated and mapped, pellet group counts were taken, trails were plotted and recorded as to their purpose, direction and season of use.

Escape Terrain - Terrain for bighorn for retreat was described in terms of distance from habitat type, type of terrain and whether the terrain is above or below the habitat type.

Water Areas - All springs were mapped and described as to bighorn use.

Mineral Licks - All mineral licks were mapped and described as to bighorn use.

Developments - Nearest land use developments were described and distance determined from habitat type.

Accessibility for Man - Access was described in degree of difficulty similar to the Sierra Clubs numerical rating system.

2 - easy walk, 0-25% slope

3 - moderate walk, 26-45% slope

4 - difficult walk, hands and feet with safety rope handy.

5 - moderately difficult - safety rope with equipment mandatory.

6 - extremely difficult - vertical cliffs.

Access was also determined for horse and motor vehicles.

GRAPHIC ANALYSIS

Since most of the data obtained during the field analysis was spatial in nature, it became apparent that it could be displayed in graphic form. The method of graphic analysis used was adopted from environmental analysis pioneered by Ian McHarg and associates in the field of land use planning (McHarg, 1969). The study area base map (4"=mile) included all observed bighorn trails, concentration areas, mineral licks and watering areas. Three valued overlays for this base map included:

Bighorn Habitat Overlays - Where vegetation, terrain (cover) and water was valued as High, Moderate or Low.

Water	- Perennial - High value	
	- Temporary - Moderate value	
	- Lacking - low value	
Terrain (Cover)	- 60% + slope within 50 yards	High value
	- 30-60% slopes within 50-150 yards	Moderate value
	- 0-30% slope beyond 150 yards	Low value
Vegetation	- Escarpment Chaparral	- High value due to high composition of preferred browse plants.
	- Timberland Chaparral	- High value due to high composition of preferred browse and herbaceous plants.
	- Escarpment (mini-meadows)	- High value due to the presence of mini-meadows (riparian) plant communities and associated preferred dryland herbaceous forage.
	- Alpine Forest	- Moderate value due to moderate densities of preferred herbaceous forage plants.

- Alpine Barrens	- Moderate value due to moderate to high densities of preferred herbaceous plants.
- Pine Forest	- Moderate value due to low to moderate densities of staple and preferred forage plants.
- Chaparral	- Low value due to high density of staple and low valued forage plants.
- Alluvial Wash	- Low value due to low density of forage plants.

The water, terrain and vegetation overlays were superimposed to produce all the relative values on the Habitat Overlay.

Bighorn Use Overlay - Based on actual observations of bighorn use (observed animals, utilized vegetation, tracks, trails, bedgrounds and pellet groups) by seasons were displayed in three values.

Light Use	- Trails with no regular or concentrated use.
Moderate Use	- Trails regularly used with small concentrations (10-20 sheep-days use per acre).
Heavy Use	- Extensive concentrations linked together with numerous trail systems. Over 20 sheep-days use per acre. Bighorn usually always found in these areas during the proper season.

Human Use Overlay - Based on actual recorded visitor-days use. Investigation found that different spatial relationship could be developed. The analysis found that when human activity in an area increased, bighorn activity in the same area decreased. This new spatial relationship includes area within line-of-sight from center of human activity to nearest cover for bighorn. Values are described as follows:

Light Use	- 100 visitor-days per year or less.
Medium Use	- 100 to 500 visitor-days per year.
Heavy Use	- 500 visitor-days per year or more.

The three basic overlays - habitat, bighorn use and human use - were then comparatively analyzed.

The results from the comparative analysis were then used to depict (on overlays) anticipated spacial impacts from expanded recreational use of bighorn habitat in an effort to provide guidelines necessary to safe guard bighorn values in the study area. Such guidelines are intended to bring bighorn values in perspective with other resource values and uses.

Projected Spacial Impact was shown on overlays to depict what would happen if maximum public use was made of the bighorn range during the summer months. The human access routes determined by the survey were shown on a Human Access Overlay. This overlay was then layed over the bighorn habitat to determine Bighorn Habitat Displacement based on minimum distances tolerated by bighorn. By assessment of this projected spacial impact, management guidelines that would minimize impact on the bighorn and their habitat then becomes apparent.

DISCUSSION

BIGHORN OBSERVATIONS

Approximately 128 separate bighorn sight records were analyzed. All observation occurred during a 10-month period providing bighorn movement patterns and concentration area in the study area. The Bighorn Occurrence Map (Figure 1) shows the extent of the concentrations and travel routes from winter to summer range.

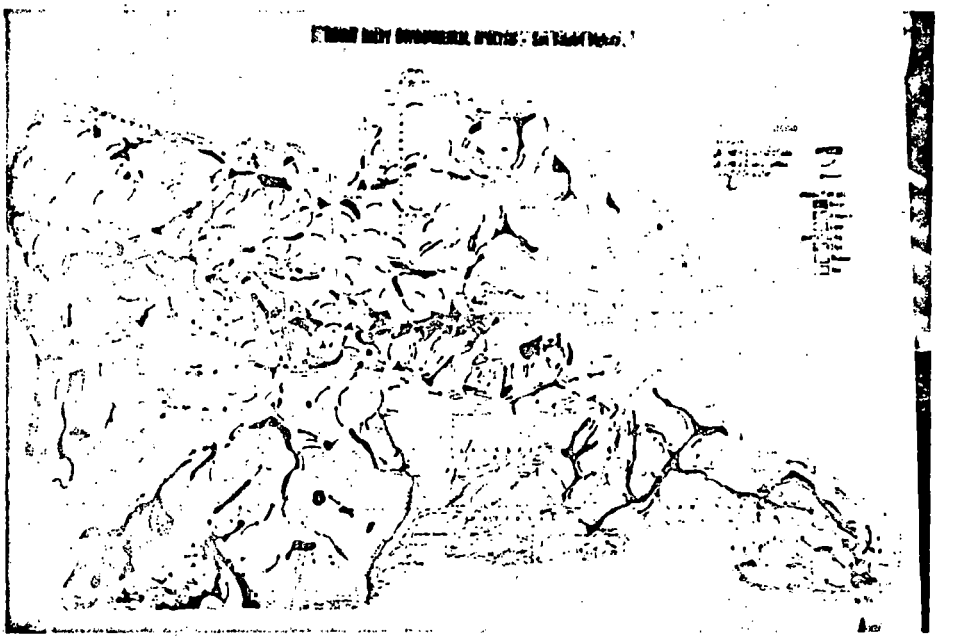


Figure 1

Bighorn observations indicate the following seasonal pattern of use.

Winter Range - Bighorn use (Figure 2) was found to be between the 4,000 and 6,000 foot elevation in the escarpment chaparral of Cattle Canyon, Middle Fork of Lytle Creek, Little Bear Canyon and probably Fish Fork Canyon. Areas of similar habitat and elevation where bighorn were not found to winter were the Coldwater and North Fork of Lytle Creek.

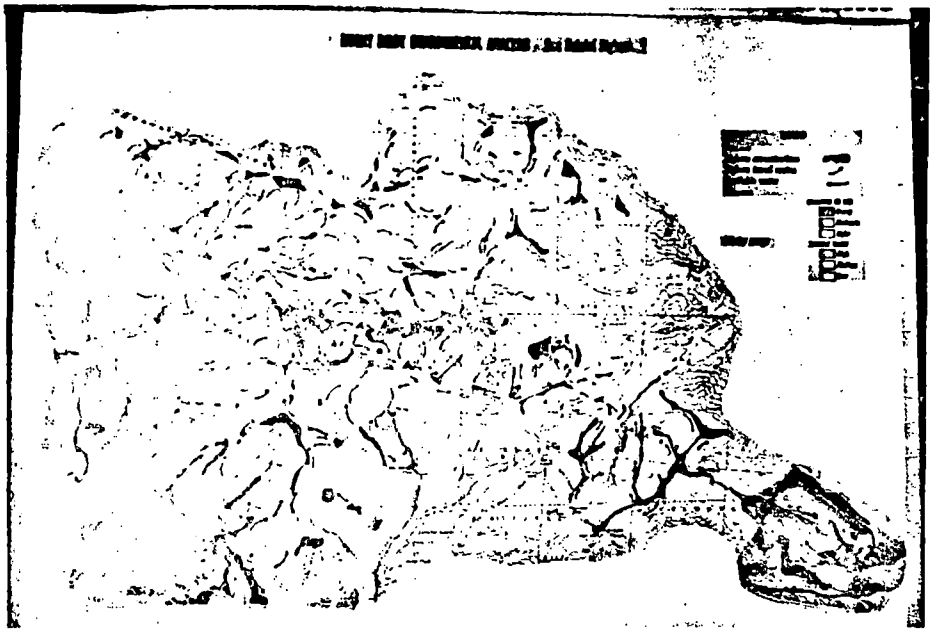


Figure 2

Spring Range - Bighorn use (Figure 3) remained in the lower rugged canyons for the ewes in lambing. While the rams advanced to the higher south facing slopes up to 8,000 feet.

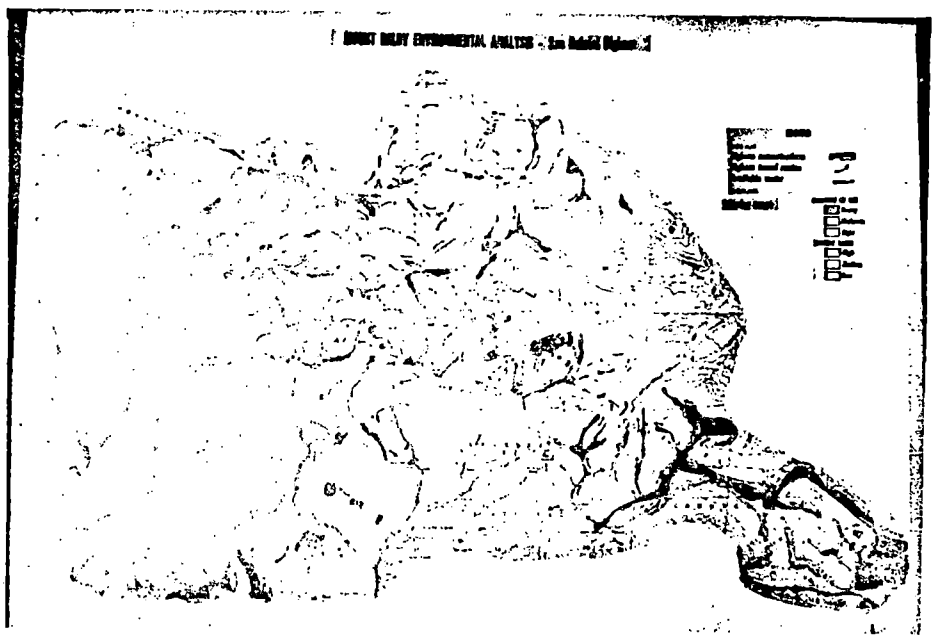


Figure 3

Lambing occurred primarily during the month of May and into June.

Summer Range - In June and July the snow pack usually diminishes on the North facing escarpments on Mt. San Antonio. At this time, most of the ewes with their lambs swarm into these escarpments to forage and seemingly to gain solitude and security.

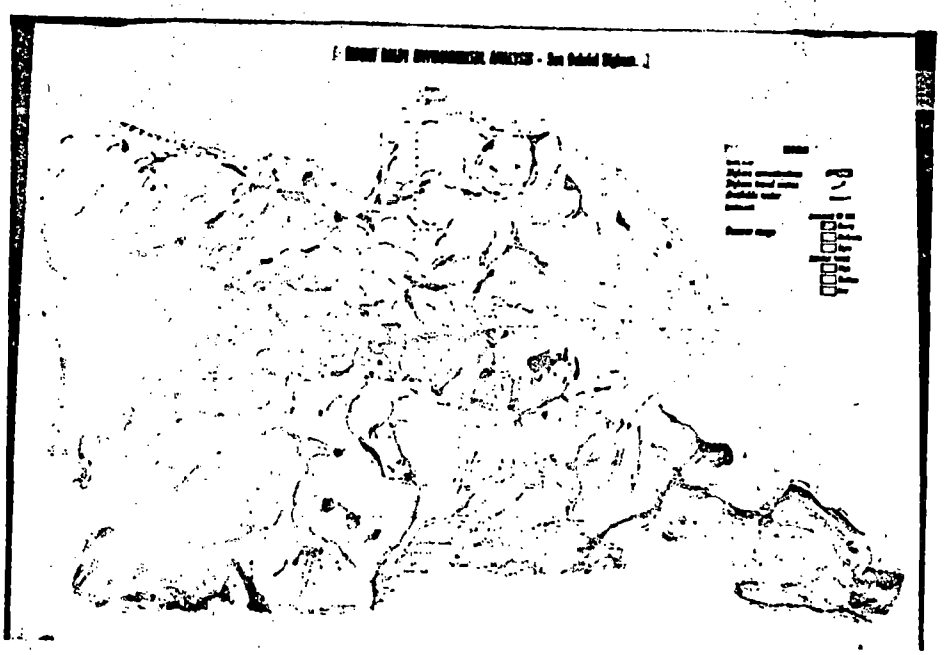


Figure 4

Bighorn generally utilize the entire range (Figure 4) in varying degrees of intensity during this time. Ram and ewe concentrations are delineated on the map below.

Fall Range - Bighorn rams concentrate, at this time, in specific areas (Figure 5) on Pine Mountain Ridge, San Antonio Ridge, Cattle Canyon, Middle Fork and West Fork tributary of the North Fork of Lytle Creek.

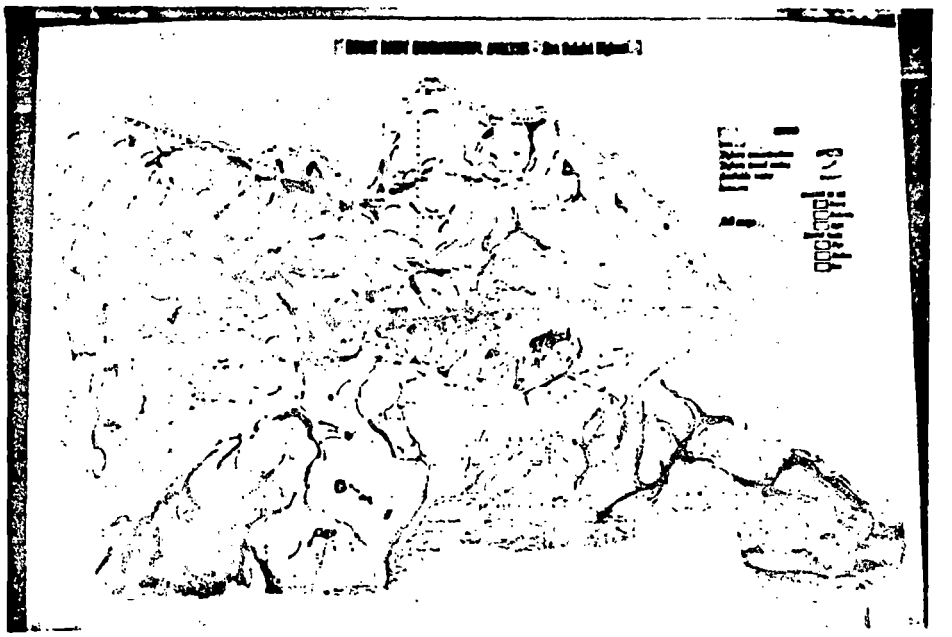


Figure 5

Ambient temperatures of areas where bighorn were sighted appeared to correlate with their seasonal elevational drift pattern. Table I provides a general idea of the elevation and temperature regimes within which bighorn are found during each of the seasons. The standard errors for the means of temperature and elevation are 6.6 degree F. and 690 feet, respectively.

TABLE I - TEMPERATURE AND ELEVATION CORRELATION FROM OBSERVATIONS

Season	Mean Temperature	Mean Elevation
Winter	43	4,300'
Spring	58	6,200'
Ewes with Lambs	73	5,700'
Summer	79	7,900'
Fall	57	7,600'
Rams in Rut	60	7,200'

The mean elevations and temperatures at the time of sighting were tabulated by months to give a general idea of at what mean elevations the bighorn may be found and at what temperature ranges they prefer.

Ewes in lambing are at lower elevations and in higher temperature ranges then the rest of the bighorn in the spring months.

BIGHORN HABITAT

Three major components of the habitat: food, water and shelter (escape terrain) were analyzed.

Water - Water, was found throughout the study area. However, it did have an influence in bighorn movement patterns. Water is common at the base of all major escarpments. There, bighorn had easy access to water within a few minutes travel. Perennial water was due to snow runoff and springs provided by geological faulting action.

Mineral Licks - During the analysis bighorn were observed eating mud at two seeps. Bighorn sign was concentrated at similar springs throughout the study area. As previously described the water comes to the surface via the gouge material between rock strata resulting from geologic faulting (Morgan Pers. Comm.). In a recent analysis of such a mineral lick conducted by the California Polytechnic College at Pomona the soil was classed as a Glade soil. Glade soils are a gray clay-gravel usually saturated with water which indicated abundant anaerobic bacterial activity. Laboratory analysis indicated the following inorganic elements of this particular Glade soil. (Moss, 1971).

ELEMENT	CONTENT
Calcium	3.4% as carbonate
Magnesium	Trace
Potassium	21 ppm
Sodium	25 ppm
Iron	1 ppm
Manganese	Trace

The mineral licks receive greatest use by bighorn when the soil is saturated with water. This use coincides with lambing activity.

Terrain - Topographic relief of the study area was described and valued according to importance as cover for bighorn. Generally, observations indicate that bighorn favored narrow promentories or overlooks in and adjacent to cliffs or escarpments. Terrain is evaluated for spatial interpretation described below.

Low Value Terrain - Slopes from 0-30 percent usually not adjacent to or more than 150 yards from escarpments.

Moderate Value Terrain - Slopes from 0-60 percent usually adjacent to or surrounded by escarpments within 50 - 150 yards.

High Value Terrain - Slopes 60 percent or more adjacent to narrow ridge tops with promentories within 50 yards.

Upon statistical analysis, however the importance of terrain appeared related to its juxtaposition to water and high value vegetation.

Vegetation - The survey area includes vegetation types within three vegetative zones - Alpine, Coniferous Forest and Chaparral. Each vegetation type within these vegetation zone was evaluated (Figure 6) for importance to bighorn. Enumerated in table II is a summary of the evaluation from the habitat analysis.

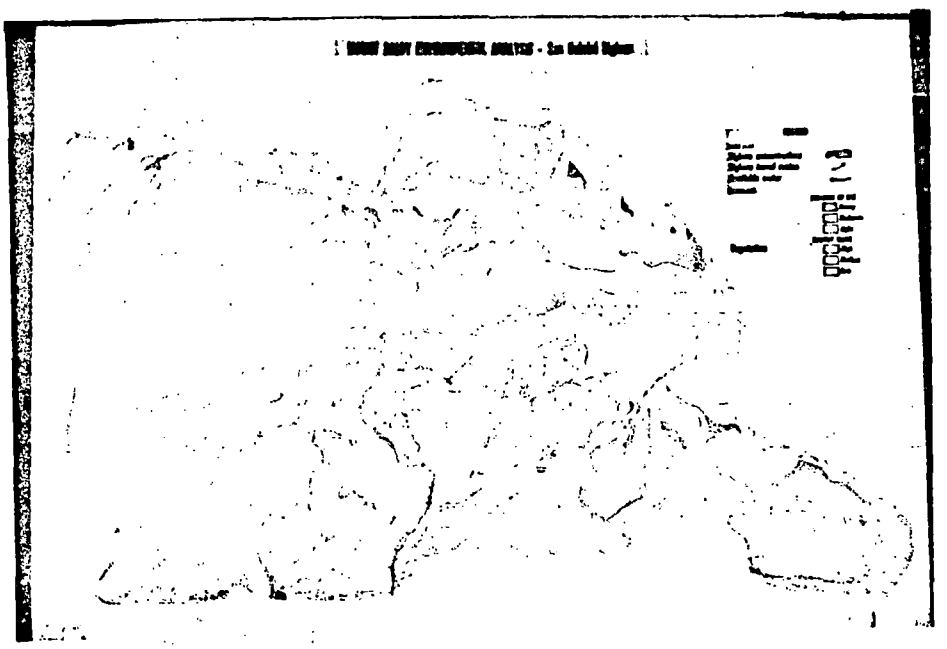


Figure 6

TABLE II - EVALUATION OF VEGETATIVE TYPES

	Escarpment Chaparral	Timberland Chaparral	Escarpment	Alpine Conifer	Alpine Barren	Conifer	Alluival Wash	Dense Chaparral
Bighorn Preference	High	High	High	Moderate	Moderate	Moderate	Low	Low
Vegetation								
Overstory density (%)	--	10	--	5	--	40	--	--
Understory density (%)	32	35	23	25	14	22	5	52
Species Composition* (%)	CEBE-12 QUDU-8 CELU-2 GR-10 PRIL-2	CECO-8 QUDU-2 CASE-5 ERO-15 GR-5	CELE-3 HOVO-5 MON-2 ERO-5 GR-5 HEAL-3	ERO-7 HOVO-4 HEAL-4 GR-5 MON-2 CELE-3	ERO-8 HOVO-1 PHL-1 HEAL-1 GR-2 MON-1	CELE-5 CECO-5 QUDU-2 ERO-8 GR-2	Gr-5	ADFA-20 CEGRP-15 CEBE-5 QUDU-10 GR-2
Soil and Rock (%)	55	50	70	65	64	47	85	35
Litter (%)	13	15	6	10	22	31	10	23

*Key to the abbreviations.

ADFA - Chamise
CASE - Chinquapin
CEBE - Birchleaf mahogany
CECO - Mountain Whitethorn
CEGRP - Desert ceanothus
ERO - Buckwheat
GR - Grass
HEAP - Heuchera
HOVO - Ocean spray
MON - Horsemint
QUDU - Scrub Oak
PRIL - Bittercherry
CELU - Chaparral Whitethorn
PHL - Phlox
CELE - Curlleaf Mahogany

Escarpment Chaparral - Typifies the winter range or lower elevation chaparral on 45 percent or to steeper slopes. Seasonal development of plants in this type provides yearlong forage. The type provides abundant green annual grass and forbs important for the spring lambing months. Shrubs of high quality are abundant and provide browse during the fall and winter months. Cherries provided by the hollyleaf cherry shrub are aggressively utilized during the late summer months.

Timberland Chaparral - A seral type, provides much high quality browse, forbs and grass for summer and fall utilization by bighorn. Bighorn rams prefer this area even in moderate terrain situations.

Escarpment (mini-meadows) - Vegetation appears to be associated with the hydrologic factor that created the escarpment. This type is generally steep and barren in appearance. At the springs however are small wet meadows or "mini-meadows". These "mini-meadows" sustain heavy summer utilization by bighorn. It is in these areas that bighorn seek minerals from the glade soils. The greater area contains sparse but highly preferred vegetation such as mint (Monardella spp.), heuchera (Heuchera spp.), oceanspray (Holodiscus spp.), narrowleaf mahogany (Cercocarpus ledifolius), and variety of low cushioned forbs and sub-shrubs including buckwheat (Eriogonum spp.). Ewes with lambs seek this vegetation type.

Alpine Forest - Includes the limber and lodgepole pine plant community which includes low cushioned plants similar to the Alpine barren type.

Alpine Barren - The vegetation community includes a sparse density of low cushioned plants such as mint, buckwheats, heuchera, oceanspray, carex species, bluegrass (Poa ovina), squirreltail (Sitanion hansenii), and other forbs which are maticulously sought out and utilized by bighorn. Bighorn were observed to walking parallel, on contour and one above the other, to more efficiently utilize these plants.

Conifer Forests - Bighorn key areas are located on benches of open stands of this type. Shrubs and low cushioned plants such as mountain whitethorn (Ceanothus cordulatus), mahogany and buckwheat species predominate the undergrowth in this type. Herbaceaus plants preferred by bighorn include bluegrass (Poa spp.), vetch (Lotus spp.) and pedicularus (Pedicularus spp.).

Alluvial Washes - Are generally void of vegetation and is little used by bighorn.

Dense Chaparral - Is generally avoided by bighorn.

Plant growth development appeared to correlate, as motivating force, with bighorn elevational drift. Food availability appears to be more important a factor to elevational drift then temperature since bighorn can thermoregulate over a fairly wide range (30 degrees to 90 degrees F.) in the survey area.

During the study, plant development and bighorn utilization appeared to coincide with the upward movement of bighorn from the winter to the summer range. Table III below provides examples of plant development stages and utilization by bighorn.

TABLE III - SEASONAL PLANT DEVELOPMENT STAGES WHEN UTILIZED

Season	Elevation	Plant Species	Development Stage When Utilized
Spring (April)	Below 4,000'	Annual Grass	Green and heads emerging
Spring (May)	5,000-7,000'	Bluegrass	Seedheads emerged
Summer (June and July)	5,000-7,000'	Vetch	Flowering
		Pediculatus	Prior to flowering
Summer (July and September)	7,000-10,000'	Mint	Flowering
		Low cushioned forbs	Flowering
		Heuchera	New leaves and flowers
		Rabbitbrush	New stems
		Oceanspray	New green growth
		Carex	New green growth
Fall (September and thru November)	6,000-10,000'	Buckwheat	Flowering
	Below 5,000'	Hollyleaf Cherry	berries ripe

By fall, water is usally available below 7,000' and the higher temperatures (80 - 90 degree F.) require bighorn to seek the lower elevations in the canyon bottoms. New leader growth on shrubs such as curleaf mahogany, (Cercocarpus ledifolius), redberry (Rhamnus crocea ilicifolia) and mountain whitethorn (Ceanothus leucodermis) receive utilization throughout the year.

BIGHORN USE AND HABITAT VALUES

Each of the graphic overlays, Vegetation and Terrain, were individually compared with the bighorn use overlays by a contingency Chi-square ( ) test for any correlation.

TABLE IV - ASSOCIATION OF BIGHORN WITH VEGETATION VALUES

Bighorn	Habitat Values ( ) High	Moderate	Low	Number of Samples (N)	Probability Level (P)
Rams	5.36	1.52	2.21	460	.02 P .01
Ewes	8.66	1.63	5.22	460	.001
Total Bighorn	13.66	3.14	7.62	460	.001

The Chi-square test on the association of bighorn with vegetation values in Table IV indicated that bighorn show a high preference for the vegetation valued as high and a low preference for vegetation valued as low.

For rams, however, more samples would be required due to their far ranging distribution behavior.

By Chi-square it was found that both rams and ewes were found in similar vegetation types. Ewes, however, showed a higher occurrence in high value vegetation types.

The Chi-square test for association of bighorn with terrain values indicates that their presence was randomly determined.

1/ = 1.88 N = 460 P = .40 P .30

The spatial analysis of vegetation inadvertantly considered water and terrain. Perhaps a better model of bighorn habitat can be prepared from detailed analysis of the ecological factors lying within each vegetative biome.

BIGHORN-BEHAVIOR

The analysis of behavior is based on observational notes. This discussion will include seasonal activities and limiting factors.

Seasonal Activities - Activities related to the seasons should begin with a discussion of the Home Range. The study area includes three distinct bighorn home ranges originating in (1) Middle Fork of Lytle Creek (2) Cattle Canyon of East Fork of San Gabriel River and (3) Fish Fork of East Fork of San Gabriel River.

There appears to be dispersal of rams and ewes between Cattle Canyon and Fish Fork in the summer range of Mt. San Antonio. Only rams disperse from Middle Fork of Lytle Creek to the summer range in the West Fork Tributary of North Fork of Lytle Creek. Ewes and rams appear in the West Fork Tributary of the North Fork of Lytle Creek from spring through the summer and fall seasons.

Lambing - Occurs in May in Cattle Canyon, Fish Fork, West Fork Tributary of North Fork and Middle Fork of Lytle Creek.

Ewes and Lambs - Move in large (10 or more individuals) bands into the summer range on Mt. San Antonio in June and stay until the end of July. Then they break up into smaller bands and concentrate near perennial water.

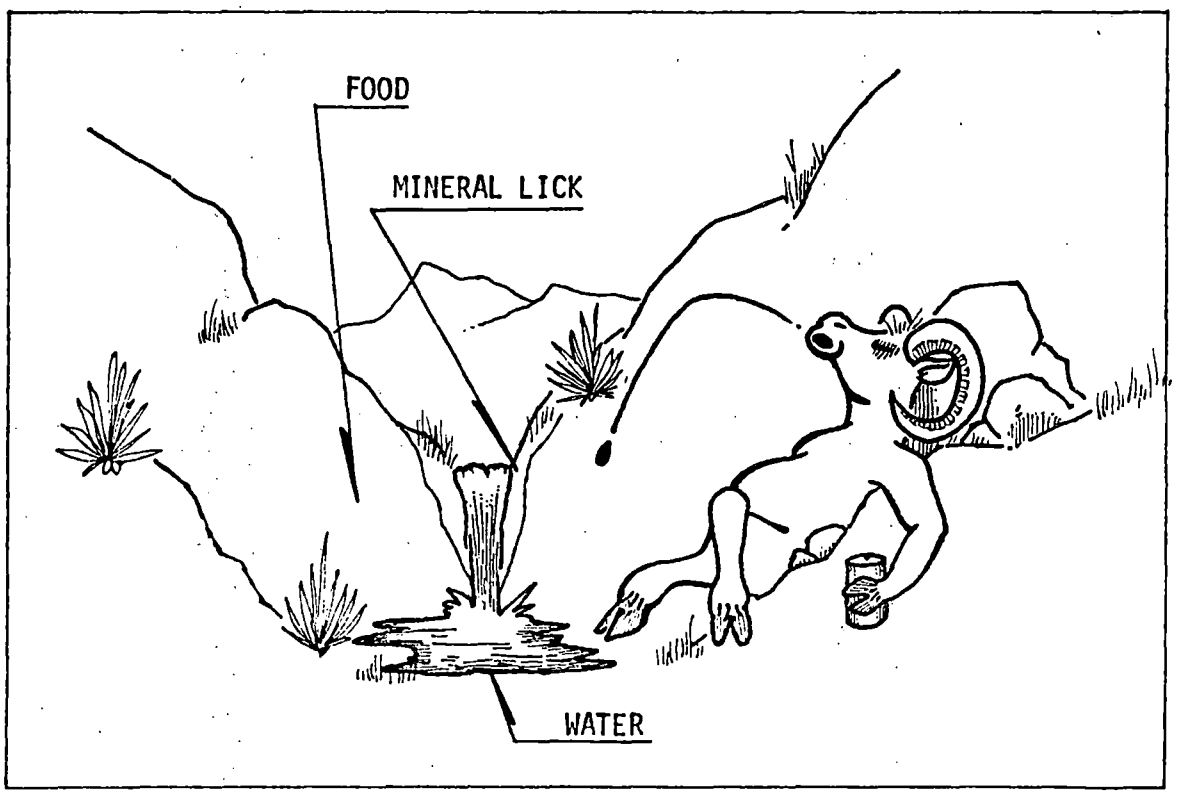
1/ NOTE: Chi-square ( ) determines the probability (P) that a pattern is randomly determined. With the P values very low, the chance that bighorn are distributed because they prefer one area over another is very high.

Rams - Rams in small groups select locations overlooking their respective home ranges in the spring and summer.

The Rut - Rams form larger groups in the fall in the habitual rutting areas near ewe concentration areas. The rutting areas are on the south ridge of upper Cattle Canyon, San Antonio ridge, South Fork of Pine Mountain ridge, West Fork Tributary of North Fork of Lytle Creek and Chalk Peak above Middle Fork of Lytle Creek. At this time the ewes are with the rams. In this case the rams locate near the ewes.

Winter Range - Finds all the bighorn in Middle Fork of Lytle Creek, Fish Fork and Cattle Canyon below the 5,000' elevation.

Limiting Factors - Water, mineral licks, vegetation, and terrain influenced by climate motivates bighorn movements in their home range. Trails for example appear to be extensive on ridge tops, to mineral licks, to springs and to preferred forage. Further study can determine how closely related and important these factors are to the physiology of bighorn in the area.



Other limiting factors include predators and man. Carnivores include golden eagle, coyote and mountain lion. Except for the mountain lion, all the carnivores listed were observed, but did not appear to be associated with bighorn kills. The golden eagle was observed harassing a band of bighorn without apparent success. However, during the analysis golden eagles were suspected of feeding on a fresh bighorn lamb carcass.

Notes were taken on bighorn reaction to man in terms of distance and type of bighorn reaction. These observations were quantitatively estimated to fit a multiple linear regression curve (Figure 7) for reaction of a herd or individual versus distance from the observer (Light, Riggan and Larson).

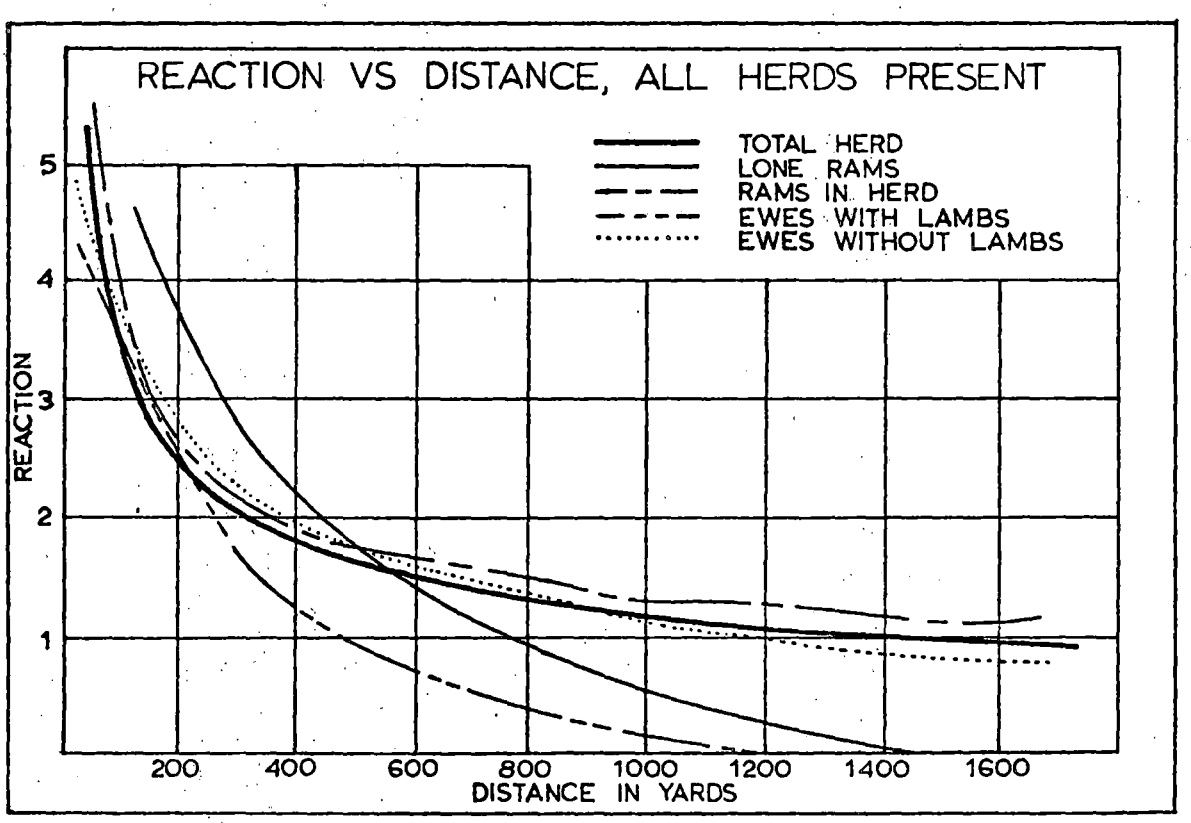


Figure 7

When deciding the distance at which man's approach can be allowed for bighorn habitat management and protection, areas known to be used by particular groups should be evaluated using the appropriate graph in Figure 7. Areas of general usage by bighorn can be evaluated by using the All Bighorn curve. Seasonal usage of areas by man might be considered when they correspond to non-usage by bighorn. The technical difficulty

will lie in deciding what level of reaction is acceptable (Light, Riggan and Larson). Recognizing that there will be departures from the curves, the recommended allowable reaction versus distances is offered from the graph curves in Figure 7. The results are shown in Table V, below:

TABLE V

TOLERATED REACTION AND MINIMUM DISTANCE FOR MANAGEMENT

Bighorn Group	Tolerable Reaction	Minimum Distance to Manage For
Lone Ram	3-Concerned	300 Yards
Ewes with Lambs	2-Curious	250 Yards
Group of Rams	3-Concerned	150 Yards
Group of Ewes	2-Curious	250 Yards
All ages and Sexes	2-Curious	300 Yards

As an example of the use of Table V for management, a trail or bighorn observatory may be constructed in a suitable site below and no closer than 250 yards of a bighorn occurrence area where ewes with lambs concentrate.

Habitat Displacement - Bighorn habitat displacement from man's past land use Figure 8 activities became apparent during the analysis. Portions of the survey area have been used heavily since the post gold rush days (light, et al, 1967). Since then the heaviest use in the Mt. San Antonio area began in 1955, when the Baldy Notch Ski Resort was in operation and later when the Club house at the head of San Antonio canyon became increasingly attractive as a summer retreat. Use of the Mt. San Antonio trail from the Baldy Notch in summer, 1970 was estimated at 1,900 visitor-days and 900 visitor-days at the Club house. Other back roads and trails where human use was experienced also were examined.

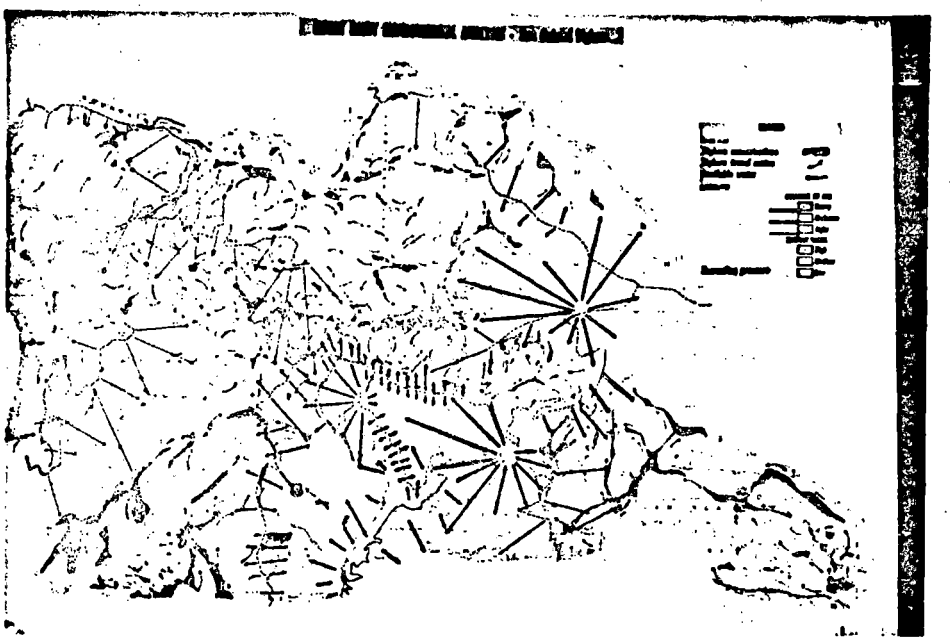


Figure 8

Further investigations of these human impact areas found that human visitation created a spatial displacement (Figure 9) effect on the bighorn habitat. Bighorn and their sign were absent in a line-of-sight pattern from the center of the human influence. Bighorn adapted to this human influence by utilizing available habitat out-of-sight of the influence. In the vicinity of a popular club house the upper most water source and entire basin of suitable habitat remains almost void of bighorn occupancy during the summer season when human use at the cabin is intense.

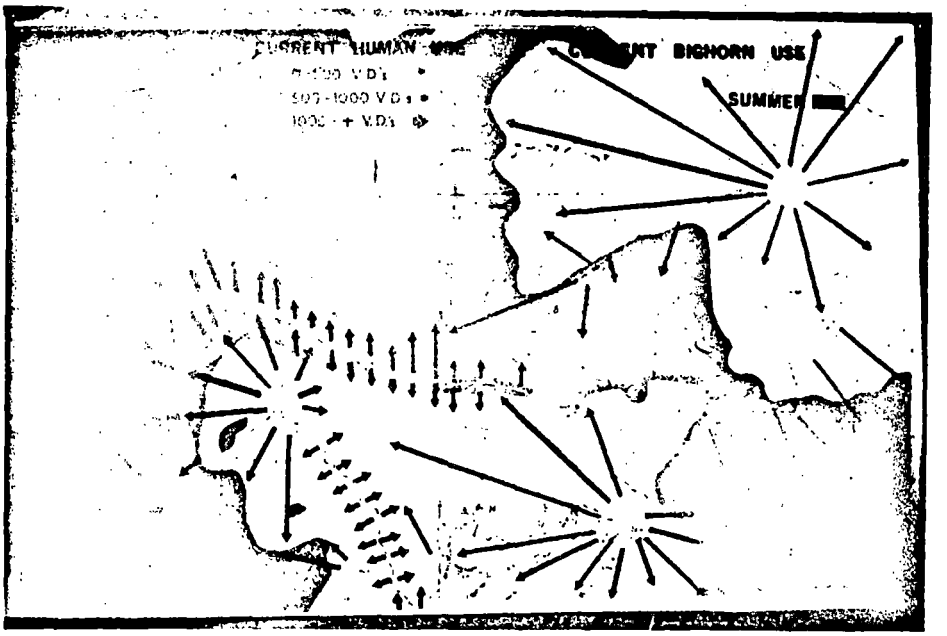


Figure 9

Other areas of habitat that bighorn have circumvented are Baldy Notch, Stockton Flat and Coldwater Canyon of the North Fork of Lytle Creek. Out-of-sight of Stockton Flat but within sight of target shooters and motor vehicle enthusiasts who drive the logging road, is a lambing area and a summer concentrating area for rams. The lambing area was used successfully by one ewe which lambed in 1971. The ram concentration area is still being used regularly by from 3-5 rams. Nine years ago the Welleses (personnel communication) observed 22 bighorn, mostly ewes, in this area. There is a strong indication bighorn will be eliminated or phased out of this area if recreational use planning does not consider the bighorn values.

To determine whether or not present human use has effected a change in bighorn concentration area, Forest Service records were studied for information about bighorn predating 1955. Considerable information regarding bighorn since 1935 was recorded by Anselmo Lewis, Mt. Baldy District Ranger, Angeles National Forest. Historic bighorn use patterns (Figure 10) within the heavy human use area were reconstructed from his and mining records (Light, 1967).

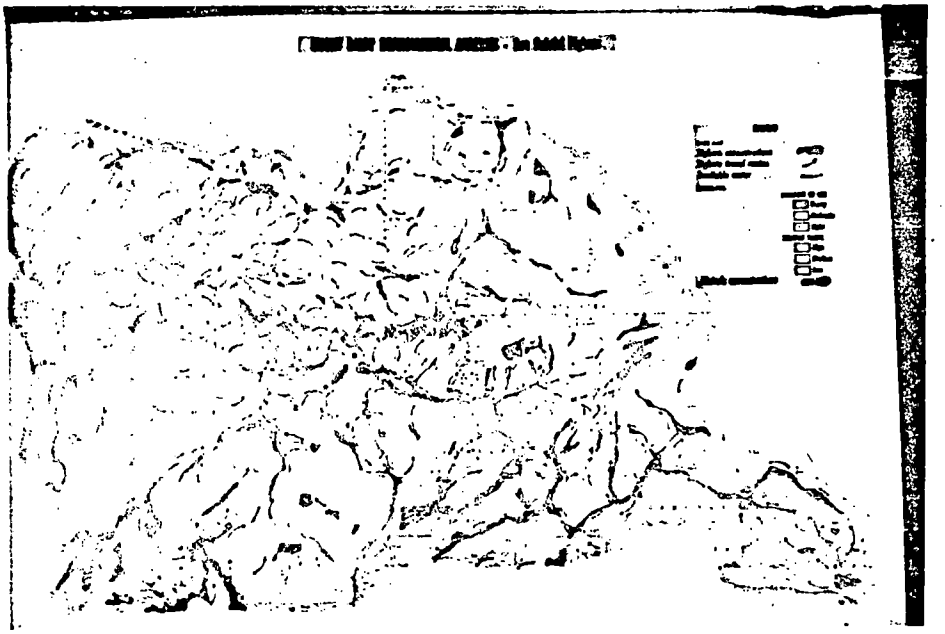


Figure 10

Graphic analysis of the habitat component, the bighorn use component and the human use component leads to some inescapable conclusions:

1. Bighorn use does not occur in significant amounts where vegetation features are of low value.

2. Bighorn use begins to diminish where human use is over 500 visitor-days per year.

3. High value habitat used heavily by man is excluding bighorn use.

Portions of the Baldy Notch development and Stockton Flats area were formerly heavily used by bighorns. Because bighorn in time have only gradually disappeared from the area as human use increased, the change was not noticed and reports painted a more optimistic picture than is now warranted.

The actual degree of tolerance as measured in human visitor days may never be known and will probably vary from place to place. Norman Simmons, (PBC-1972) in speaking of desert bighorn feels that "the stress shown by

mountain sheep is in direct relationship to the abundance of other habitat components". That is, where there are abundant food and water supplies in close proximity with high value escape terrain more human disturbance may be tolerated.

The Mt. San Antonio area, while comparing favorably with other ranges in Southern California, nowhere near approximates the forage abundance seen in bighorn habitat in areas such as the Sandia Mountains on the Cibola National Forest. The Rocky Mountain bighorn (another sub-species) which has been noted as quite tolerant of man, generally occurs in mountain ranges of northern latitudes where rainfall and resultant forage is abundant. Parry Larsen, Biologist, New Mexico Fish and Game Department, observes that the rocky mountain bighorn were used to people and were transplanted in an area (Sandia Mountains) already partially developed with roads and camp sites. "The herd prospered during a twenty-year period when human use was slowly increasing. The bighorn decline in the Sandia Mountain roughly coincided with the period of tramway construction activities and accelerated people pressure, though we cannot demonstrate that there is this direct cause and effect relationship" (Larson, written Communication, 1970).

The above observation coincides with the findings of this study - that bighorn tolerate only limited amounts of human disturbance before they are in time driven from their home range.

SPECIFIC IMPACTS OF MODERN MAN

Rapid growth, increased mobility and an ever increasing desire for outdoor recreation experience is bringing man into bighorn range in the San Gabriel Mountains. Bighorn use of its habitat has been discussed. The spatial relationship between man and bighorn in terms of habitat displacement has been evaluated. The discussion should now relate to mans specific activities in relation to impact on bighorn.

Recreation activities are many and varied as man's imagination. Those activities occurring in the study area are discussed below:

Hiking Alone - A transient, occasional hiker has little lasting impact on bighorn. This report indicates less than 700-visitor days per year in any one area may be tolerated.

Hiking in Groups - Bighorn tolerate some disturbances. Continued, frequent and especially, erratic disturbance causes them to avoid concentration areas. Richard Weaver of the California Department of Fish and Game concludes that "groups of hikers often cause bighorn to avoid their habitat" and further states that, "roads and trails in prime bighorn habitat are bad news, because their use will increase and bighorn habitat will be displaced". This report verifies Weaver's conclusions and further suggests that existing trails into bighorn habitat have hiker limitations of no more than 10 per group per day per area and no more than 700-visitor day per area per year.

Horseback Riding - Horseback riding does not detrimentally effect bighorn (DBC, 1972). The study area is very difficult to negotiate on horseback. The Devil's backbone trail is impassable. Horses may be brought into the Fish Creek trail from Pine Mountain Ridge. Here again, man activity when off the horse should be considered and groups of horsemen should be regulated in size and frequency as in hiking in groups.

Motor Vehicles - Closed cars and trucks have little detrimental effect on bighorn (DBC, 1972). Motor bikes and snowmobiles on the other hand have caused bighorn to temporarily leave their sanctuaries. The motor bike with its noise and erratic, unhorselike appearance and movement, appears to spook bighorn. Buck's Point in the South Fork of Lytle Creek is a case in point. Motor bike penetration deep into the Pine Mountain Ridge, Fish Fork, and North Fork of Lytle is increasing.

This report suggests restriction by numbers, of motor bikes to existing designated roads in bighorn range.

Odor of Man - Bighorn when confronted by the scent of man will spook and leave the area often before man or bighorn see each other (DBC. 1972).

Shooting - Discharge of firearm's within the bighorn range needs to be controlled. Indescriminate shooting in the campground areas and from the trails at any convenient target is a continuous disturbance to bighorn in South, Middle and North Fork of Lytle Creek. Unoccupied bighorn range near Stockton flat and the Coldwater tributary to Lytle Creek may be a result of the high incidence of "target" shooting. Bighorn have continuously been illegally taken from within the study area. In the South Fork of Lytle Creek two bighorn were killed and only their heads removed in June of 1972. Discharge of firearms should be limited to taking of legal game in season.

Deer in the bighorn range are uncommon. The harvesting of deer and other game should continue to be lawfully harvested. Hunters and shooters, however, should be informed continuously of the bighorn values.

Aircraft - Bighorn in most cases run when pursued by helicopter (DBC, 1972). Infrequent surveys of bighorn by helicopter may be tolerated but if this becomes a sport, controls should be instituted to regulate this activity.

Skiing - Ski lifts and tramways have little lasting effect on bighorn during the snow season. Obviously, because bighorn are absent from what normally is their summer range. The problem is the resultant summer recreational use, where the base of the lift is in relation to yearlong bighorn range and what impact construction may have on bighorn use of their range.

Reduction in bighorn numbers appeared to coincide with the tramway construction and excellerated recreational use on the Sandia Mountain (Larson, 1970). This bighorn herd of the Sandia Mountains was considered used to people, but rather gave up its habitat to human encroachment.

This report suggests that the Mt. Baldy Ski Resort has had considerable lasting effect on bighorn and its habitat. The spatial analysis of this study brought attention to this and further analysis indicated that bighorn now circumvent the Baldy Notch area. The area gets steady use during the summer because hikers have to go through the area to hike to Mt. San Antonio. At least 5,000 people hike or drive to Baldy Notch annually during the summer months. If we assume that the relatively high use by bighorn of adjacent areas once extended into this area of equally good habitat, then we must conclude that the bighorn have been displaced by the development.

Tramways with their moving gondola cars are tolerated by bighorn (DBC, 1972). New ski area should not be cleared of all vegetation and soil. A ski area, properly landscaped, can provide for forage, water and cover to benefit bighorn.

Campgrounds or Improved Wilderness Camps - Located near natural water, mineral licks and important foraging areas have decreased in bighorn use as recreational use has increased (DBC, 1972). Such areas are designated in the survey area as well as in other areas in the San Gabriel Bighorn range.

Timber Management - Logging practices in bighorn range should be done at a time when bighorn are absent from the area or when snow is on the ground.

Fire Control - Numerous observations have been made of bighorn utilizing heliports and the vegetation in fuelbreaks (DBC, 1972). Providing drinking water and forage through fuel modification can be compatible with bighorn management.

Grazing - Grazing of cattle and domestic sheep should not be within two air miles of the bighorn management unit perimeter.

PROJECTED SPACIAL IMPACT

Bighorn sheep in the San Gabriel Mountains normally live in an isolated situation of rough broken terrain. Their habitat includes the characteristic terrain accompanied by a wide variety of transition and alpine forage plants, water and mineral licks. Except for the rams, the ewes with their young concentrate in one canyon or watershed the entire year. They are dependent upon the whole range and use it efficently for their survival.

It is inevitable with nine million people adjacent to the San Gabriel Mountains, that this bighorn habitat will become increasingly popular to man as a recreation attraction. Current recreation use, hiking, in the Mt. San Antonio portion of the bighorn range is over 5,000 visitor-days annually. This amount of use is already having an adverse spacial impact on bighorn use of its habitat (Figure 11).

Such impact on bighorn use of its habitat was isolated graphically by the study of bighorn habitat surrounding Mt. San Antonio. Additional use of this area by the public will adversely affect bighorn values unless coordination guidelines are provided and implemented to protect their bighorn values.

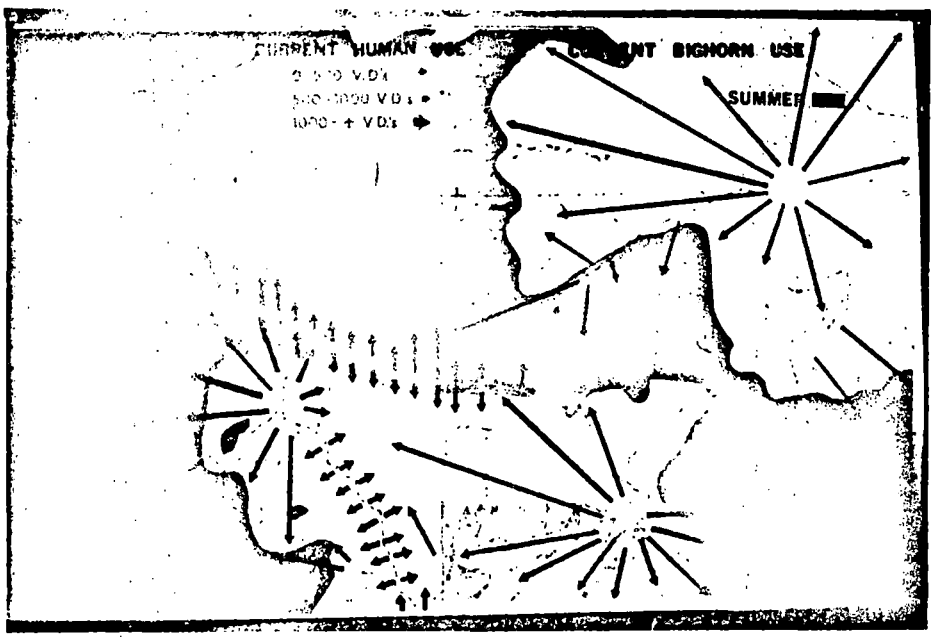


Figure 11

Projected Spacial Impact - The study (Graham, 1971) has indicated that bighorn winter range will not be affected by ski developments or other winter oriented land use. Bighorn spring, summer and fall range that is accessible to the public by foot travel (Figure 12) will be affected. The survey indicates that, in accessible bighorn key areas, summer use somewhere between 500 to 900 visitor-days per season caused bighorn to avoid their historic range.

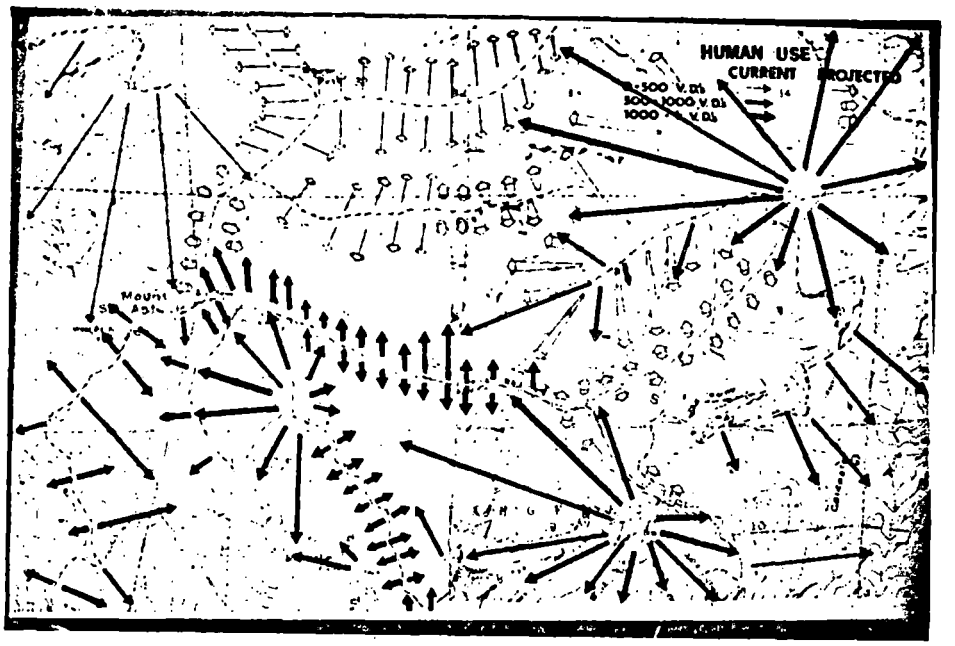


Figure 12

Human access - Projected human use (Figure 13) of the study area is along cross country routes determined by degree of human accessibility and location of projected public concentration areas or let-off and pick-up points.

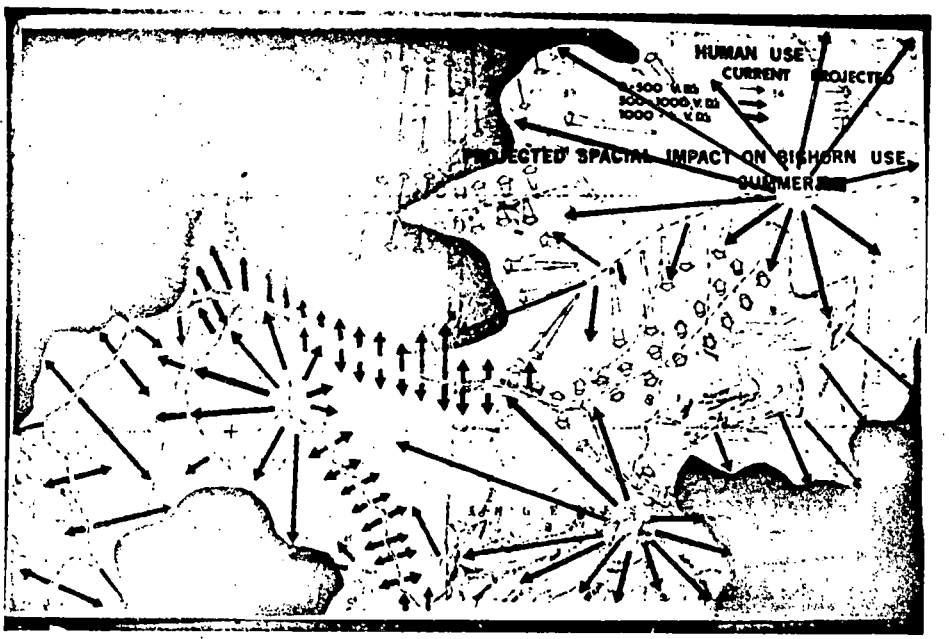


Figure 13

Projected increase in human use during the summer resulting from uncoordinated recreation use of the study area is expected to be well over what bighorn will tolerate.

Bighorn Habitat Displacement - Projected spacial displacement of Bighorn (Figure 14) in their habitat resulting from this projected recreation use was indicated by combining human travel routes to and from projected concentration points with tolerated reaction distances determined from the study (Table V).

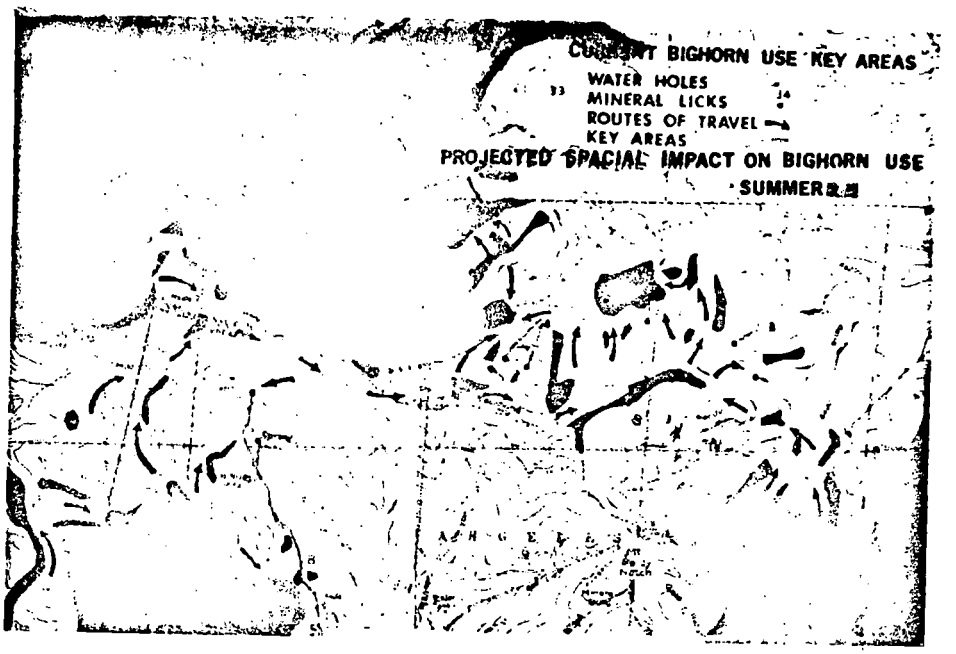


Figure 14

Table V was developed from bighorn observations which indicated types of bighorn reactions at corresponding distances from the observers. Estimates shown in Table V, developed from multi-linear regression curves, indicate that bighorn tolerate an average minimum distance of 300 yards encroachment by man. Minimum tolerable distances varied according to bighorn group size and sex and the number of observers in the group. Ram groups appeared to tolerate man up to 120 yards while ewes tolerate man up to a minimum distance of 350 yards.

The maximum or ultimate spacial displacement of bighorn use shown in Figure 14 indicates that bighorn will be crowded into already occupied range. The final result may be a reduction in numbers by crowding of the population resulting in (1) insufficient forage, (2) increased predation, (3) increased disease and (4) external harassment (Berwick, 1968 and Hansen 1971). Any curtailment of bighorn movement will result in reduced gene flow and gene pool size (Hansen, 1971) which may ultimately affect the future existence of the population.

Combining these conditions may result in population reduction. There are no other suitable areas for bighorn to occupy successfully, thus they must self-regulate their population size to coincide with the remaining habitat.

CONCLUSIONS

MANAGEMENT IMPLICATIONS

To conclude, the findings of this bighorn environmental analysis indicate that bighorn can tolerate only limited amounts of human disturbance before they are driven from their home range. Recent studies by Valerius Geist, foremost expert on mountain sheep behavior, provides some key points, enumerated below, for us all to consider in bighorn habitat management (Geist, 1971).

1. Bighorn maintain their area of distribution as a living tradition and rarely depart from it.

2. Bighorn fail to extend their range despite ample opportunity.

3. At the level of maximum food intake, sheep cannot compensate for energy lost by eating more forage but only by eating better forage.

4. The average females in stable populations at carrying capacity, are hard put to obtain sufficient high quality forage to support adequate fetal growth.

5. Evolutionary selection has eliminated tendencies in individuals to disperse from the known range pattern since knowledge of the limited available habitat favors survival.

6. Rams often have up to seven distinct home ranges which are often widely separated. Ewes typically have at least four.

This report then suggests Alternatives for management of the bighorn range in this area.

ALTERNATIVES

Alternative No. 1 - Manage the Area According to Existing Guidelines

Current multiple use coordinating instructions, found in the Cajon Ranger District Multiple Use Management Plan, for the High Country Zone include under Wildlife two instructions, "encourage the use of these areas for public hunting under State law where public safety is not endangered" and "give full consideration to non-game wildlife in habitat development, including song birds, endangered species, beaver and other small mammals." The first two management decisions in the District's Bighorn Unit indicate "bighorn have priority over other uses where those uses could cause damage or losses of key portions of the bighorn range" and "when establishing new roads, trails, campgrounds, try to locate them so that the bighorn range will remain undisturbed. Consider relocation of the San Sevain Road to avoid heavy traffic at Buck Point."

It may be inferred from these instructions and these management decisions that action will be taken to prevent undue disturbance of the bighorn. This might also infer the use of a Tramway to the top of Mt. San Antonio with restrictions.

Advantages - By following current instructions no significant changes are required, so little administrative time will be involved.

Current guidelines are generally enough to permit wide flexibility of management.

Disadvantages - By their vagueness there is no assurance that action will be taken to positively limit numbers of people using the area.

Inaction may lead to heightened demand toward a more restrictive classification, such as, Wilderness.

Alternative No. 2 - Develop a Specific Action Plan to Positively Limit Human Use of the Area During Seasons of Conflict

This alternative would require the establishment and posting of a boundary, the limitation of use as contained in a Public Notice under authority of CFR 251.25, Title 36, and the administration of a permit system within the area and the enforcement of the restrictions.

Advantages - This would help ensure that human use was limited to numbers tolerated by bighorn, thus assuring their continued well-being within the area.

It would show positive leadership in protecting environmental values of high concern to large segments of the public.

While limiting use, it would not preclude other management activities not in conflict with bighorn.

Disadvantages - It would be costly in time and money for establishment, administration and operation.

It would limit recreation opportunities in an area of growing need for outdoor experience.

Alternative No. 3 - Close the Area to Human Use

This alternative would be accomplished by establishment of a natural area, zoological area, bighorn sanctuary or some other preclusive classification, under the Regional Forester's or Chief's authority.

Advantages - This would help to insure that the bighorn remained undisturbed.

This classification would have a kind of permanency that many preservationist groups favor.

Disadvantages - Low concentration recreation opportunities would be completely eliminated.

Needed cultural work (even for the benefit of bighorn) might not be permitted.

Management and enforcement would be costly and difficult.

Alternative No. 4 - Manage the Area as Wilderness

Upper tributaries of the East Fork of the San Gabriel River and including Devil's Backbone, Mt. Harwood, Mt. San Antonio, Dawson Peak and Pine Mountain down the Lytle Creek wash has been proposed by various groups as the Sheep Mountain Wilderness. The Forest Service has listed the East Fork of the San Gabriel River watershed portion of this survey as a Roadless - Undeveloped Area. It has been tentatively selected by the Chief for further study by the Forest Service.

Advantages - If a Wilderness Area was established it would insure that the area would be administered under the provisions of the Wilderness Act of 1964.

This action would minimize administrative problems to only those of wilderness management.

Disadvantages - This action would reduce bighorn habitat management opportunities such as vegetation plantings and opportunities for taking on or dispatching bighorn surveyors by helicopter. Obtaining bighorn for transplanting from this area would be costly and time consuming without helicopter support.

This action would not limit recreation visits unless special limitation on visitor days are imposed by the Wilderness Permit System. Such action would require additional administrative responsibilities.

SUMMARY

Because of the great deal of interest being shown the bighorn, segments of the public want to establish a wilderness for their protection. Evidence from this environmental analysis indicate that increasing human use is causing loss of bighorn values. It seems imperative for these reasons that the Forest Service step out into a position of leadership and undertake the difficult job of truly quaranteeing management of the bighorn range. Alternative No. 2 is recommended as being in the best interest of the bighorn and in keeping with the Multiple Use-Sustained Yield Act of 1960 and the National Environmental Policy Act of 1969.

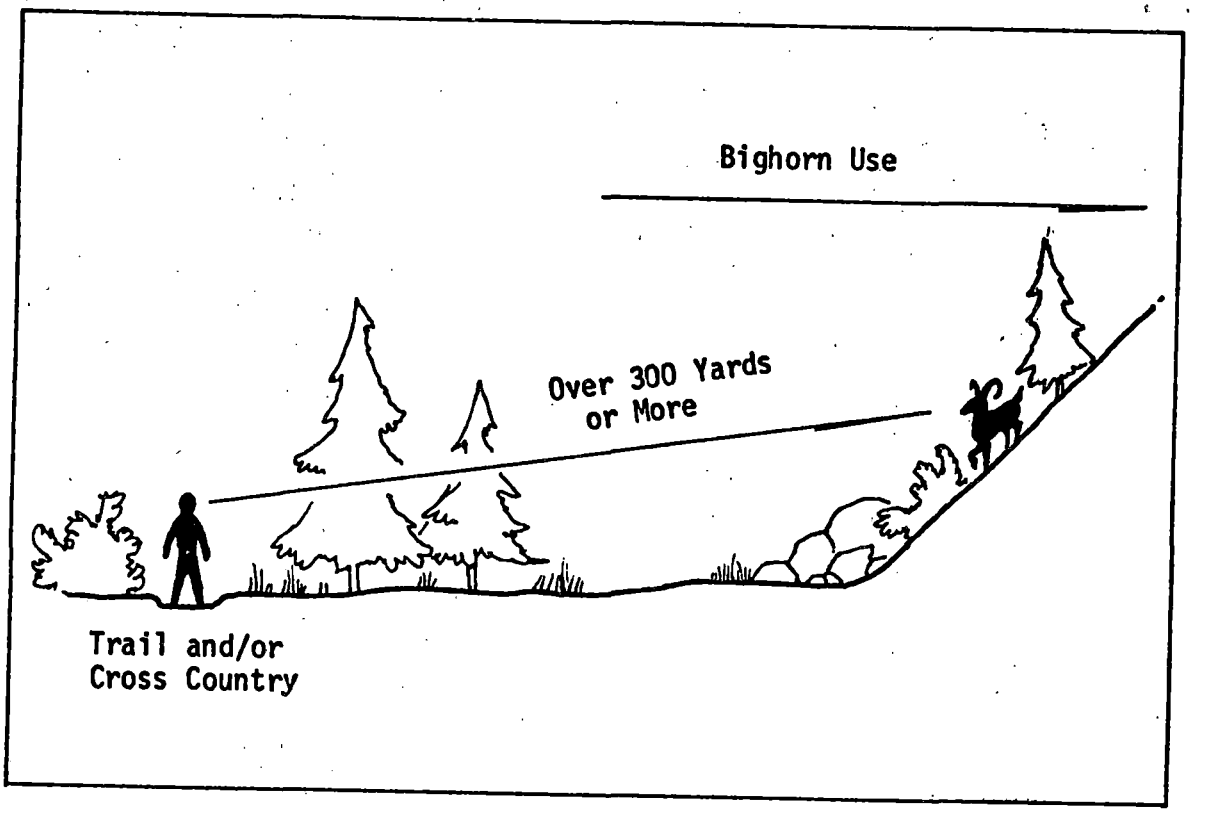
Such a change in management should be thoroughly discussed with the public and a detailed plan showing the boundaries, the methods of posting, and the plan for enforcement should be drawn up. The details of the permit system should be spelled out as currently being done under existing Public Notices No. 1 - 5.

FACTORS FOR GUIDELINES

An analysis of data from the study indicates that guidelines are necessary to safeguard bighorn values in the study area.

Factors that should govern the development of such guidelines are listed below.

1. To best maintain bighorn values in the study area, all summer recreation travel routes should be at least 300 yards or out of sight of bighorn concentration areas.



2. Public travel routes should be at least 150 yards or out of sight of known ram concentration areas only.

3. Cross country travel should be discouraged during lambing season (April - June).

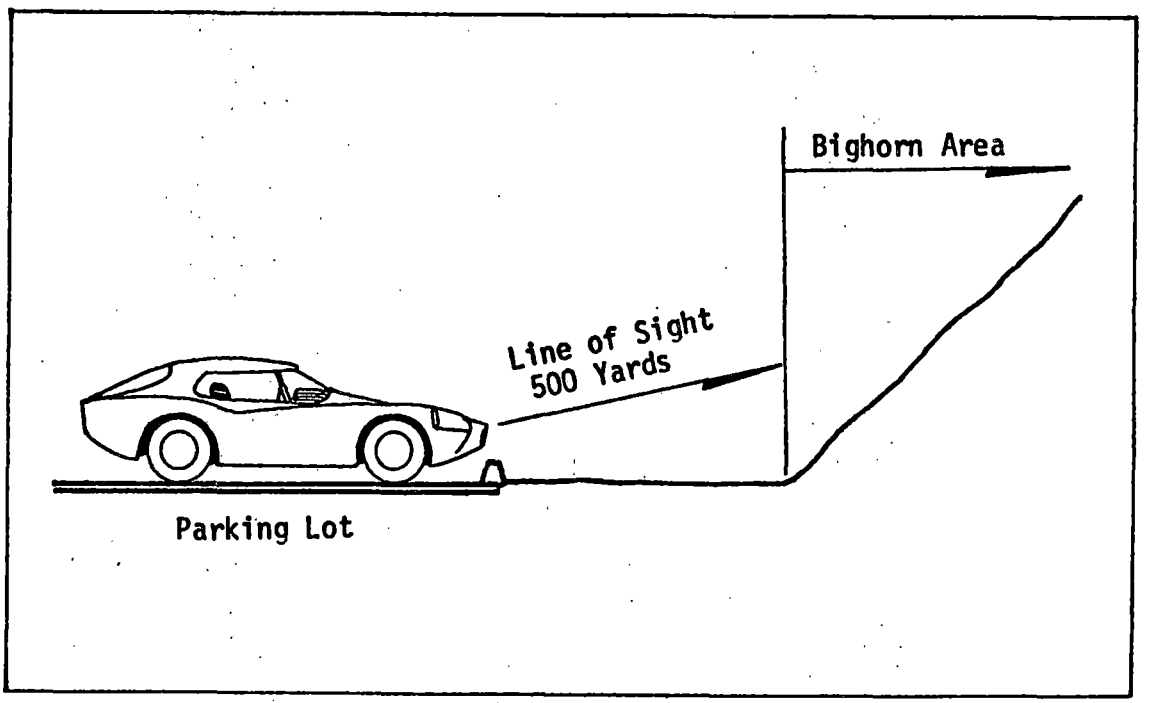
4. Summer recreation use of key areas of the bighorn range should not exceed 500 visitor-days during the months of June through September.

5. People should not be in groups larger than 10 individuals in bighorn range.

6. Recreation developments for summer use should be discouraged in key bighorn range.

7. To minimize conflict with bighorn values, all construction of developments such as electronic sites and ski facilities in bighorn range should be scheduled when bighorn are least likely to be in the area. No construction during the period December through June in winter and spring range; no construction during the period June through October in summer range; and no construction during the period October through December in fall range in the study area.

8. Areas of major human concentrations, such as parking lots, trail heads, or tramway dispatch areas should not be allowed within 500 yards and within sight of bighorn key areas or travel routes.



9. Timber should be harvested (removed) during the winter months in the study area.

10. Key bighorn areas should be withdrawn from mineral entry.

11. Vehicle use should be confined to existing roads in the study area.

12. Helicopter observation of bighorn should be for scientific purposes only; be on a designated flight plan; and before April and after June.

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